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The extermination of tuberculosis. Preser



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THE EXTERMINATION OF TUBERCULOSIS.

Preservation of Milk and Raising of Calves,

*Lecture Delivered March 16, 1904, at the Agricultural Exhibition,
at Bonn.*

BY

PROF. DR. E. VON BEHRING (Marburg),

INCLUDING A

*DISCUSSION, at the Session of the Cattle Raising Section of the
Agricultural Association of Rhenish Prussia.*

PROF. VON BEHRING:

Your Excellency, Mr. President, and Gentlemen.

I have gladly accepted the invitation of your Chairman, to deliver a lecture on the Extermination of Tuberculosis, the Preservation of Milk, and the Raising of Calves, because I believe that the co-operation of the gentlemen, who are now investigating and experimenting on the subject, and the practitioners is one of the main conditions to insure ultimate success.

I presume it is generally known, that I have succeeded in discovering means by which we are able to immunize cattle and protect them against tuberculosis, just as human beings are guarded against smallpox by vaccination. This means consists of a medicated culture of live human tubercle bacilli. There exists therefore a perfect analogy between the protective culture for cattle tuberculosis and the smallpox preventative. Jenner's protective serum is nothing else but medicated smallpox virus.

I will here add a few words as to what is understood by "virus." Any serum with live bacilli and able to generate disease is called "virus." On the contrary, the word "vaccine" has been generally accepted to designate those media which are used to prevent malignant diseases, since Pasteur has thus called them. But this is not quite logical, the word "vaccine" being derived

from "vacca," that is cow. Following these lines, I would have to call my preventative "anthropin," since it has its origin in man. But the name is immaterial and the point of importance is to know the *origin and the action* of this preventative virus. In this case the therapeutic medium is a virulent medicated culture of human tuberculosis.

My preventative against tuberculosis, as well as Jenner's preventative against smallpox, consists of live bacilli. But as soon as the live bacilli are destroyed by means of heat, the preventative action ceases. A virus may still be present, but this can hardly have a preventative power against the disease. In reality, such a virus with destroyed bacilli is employed in the form of Koch's tuberculin, which is obtained by heating the liquid culture up to about 80° C. and condensing it.

After removing the bacilli from the condensed liquid, there remains a thick brown serum which Koch has named "Tuberculin." Tuberculin lacks just that culture ingredient, which is of the greatest importance for my preventative, namely the live and germinating bacilli.

I do not think it out of place to mention this, because many eminent investigators are still of the erroneous opinion that my vaccine has the same effect as Koch's tuberculin; but this is not at all the case. As you are aware, Koch's tuberculin is of the utmost value in the diagnosis of tuberculosis in cattle, while my vaccine is a *therapeutic preventative* for healthy cattle.

If I mentioned above the similarity of Jenner's preventative and my tubercle vaccine, I must state here that there exists also a great dissimilarity, as to application. The former is brought under the epidermis on any part of the body, whilst my vaccine must be brought directly in contact with the blood. After many experiments, I found that success is sure to follow, if the vaccine is injected in the *jugular vein*, and only after I had come to this conclusion, a trial could be made to introduce the method in practice. This method I called "Jennerization-method," because Jenner was first to introduce the medicated culture of a virus. In the interest of justice, it would probably have been more correct to name the method after Pasteur, but as this name was already made use of for the well-known method of conserving milk, I have chosen the above.

It may be of general interest to discuss the question, why in one case best results are obtained by applying the vaccine below the epidermis, and in the other, by injecting it into the blood circulation.

It is a well-known fact, that germs of different diseases possess peculiar affinities towards certain tissues and cells. By applying

smallpox vaccine subcutaneously, the process of inflammation is localized upon the point of vaccination. If we would inject the lymph into the blood circulation, this would no doubt cause pustulous eruptions of the epidermis and of the mucous membranes as far as they come in contact with the air.

In glanders it is similar. You may obtain a localized primary inflammation by injecting the virus hypodermically; but, on applying the virus to the blood circulation, you will always find an affection of the nasal mucous membranes.

In smallpox, mostly the epidermoidal epithelial cells are affected and in glanders the substance of the connective tissues.

In tetanus, we find that the muscles of the tail, maxillary bones, and particularly the eyelids are affected, although we know that these are but secondary symptoms and that the nerves are to be considered the first points of attack for the tetanus bacilli.

In anthrax the epithelial cells of the blood vessels are first affected.

Recently we have succeeded not alone in proving these specifications theoretically, but also practically, and thus an essential progress, in veterinary as well as human medicine, has been made. You will see that this knowledge has become of extraordinary importance for the successful suppression of tuberculosis in cattle.

In former times, the point of attack of the bacillus tuberculosis has been much discussed; but it has always been looked for in the wrong place. The connective tissues were supposed to be the primary seat of the infection, because visible changes were first noticed in these tissues. In reality it is to be found in the movable cells—the white blood corpuscles. These cells are attacked first by the tubercle bacillus and following these, the cells of the muscle wall of the blood vessels.

This prompted me to inject the vaccine into the blood circulation and not under the epidermis.

What is said here has been repeatedly stated by me in the course of recent years and will also be found in reports published by myself and by my colleagues. I have been greatly assisted in my endeavors to suppress tuberculosis by a number of agriculturists, among others, especially Count Zedlitz. It was he who practically cleared the road for me in Hesse-Nassau and enabled me to practice my method, and to him I am indebted for the information I have obtained as to the spreading of the disease, which breeds were mostly affected, and the different ages of the infected animals. I have also been kindly assisted in my work by the agriculturists and veterinarians, so that I was enabled to apply the tuberculin test to about 3,000 heads of cattle within one

year. The statistics of these tests revealed a very remarkable fact, namely, that in large stables holding 40 to 50 heads of cattle, most of the animals reacted to the test, whilst in stables with 2 to 4 animals only but 3 to 4% were infected. I found later that this condition prevailed everywhere.

Prof. Bang states: "The farmer can save himself the trouble of testing cattle, which are kept in old stables and in large numbers—the majority of them will react." I had occasion to become acquainted with the infection conditions of suckling calves, and the questions of stable hygiene, from a new point of view, and to also study the question of the preservation of milk, and I have come to the conclusion that theories must be continually controlled and corrected, to render them of use to the practical breeder and dairyman.

The first practical application of my method was made in three counties in Hesse-Nassau, and also in this first step, Count Zedlitz has aided me very much. Later on, estate-owners in Hessa, South Germany, Mecklenburg, Hungaria, Bohemia, Silesia gladly had their herds immunized and even had control tables issued of each immunized animal. I am sincerely grateful for the aid given me by these gentlemen. I am especially indebted to *Baron von Leonrod* and *Dr. Strelinger*, who have made the first practical experiments with my preventative at the Hungarian estates of Prince Ludwig of Bavaria; *Count Schwerin-Göhren* and *Count Wolfshagen*, as well as *Mr. Ebeling* in Mecklenburg, *Messrs. Bolle*, father and son, *Mr. von Walchern* and *Mr. Rösler* in Teschen, to the latter especially because of his efforts to lay a scientific foundation for the raising of calves with milk rendered aseptic by means of formaldehyde (1-10,000). Further to the *Duke of Trachenberg* and *Count Oppersdorf* of Silesia. Of the prominent veterinarians I mention but the following: *Messrs. Lorenz, Johne, Eber, Hutyra, Schlegel, Casper*, whose names are well known in science, as well as in practice.

The vaccination for tuberculosis, like that for anthrax, is done in two instalments, but usually the second vaccination is to be made twelve weeks after the first. The virus consists of dried tubercle bacilli. The stability of this dried virus is such that we are enabled to send it even to America, without fear of deterioration. Dr. Lorenz drew my attention to the fact that, if the vaccine is injected into the blood circulation without having been heated up to the blood temperature, a collapse of the injected animals is the result. This happened at a farm in Hessa on a cold winter day; however, it was not caused by the vaccine, but would have occurred even had the liquid only been injected. On the day following, the calves had entirely recovered.

The dry tubercle virus must be well powdered before being made into an emulsion, so as to avoid the entrance of larger particles into the blood circulation. Then the emulsion is put into a waterbath and is heated up to 100° F.

Dr. Lorenz, in his paper on this subject, states:

"After all that I have so far seen, I am under the impression, that here we have a method which insures success. This method is of immense value and surpasses all others, as to cheapness and easiness of application. It will supersede all previously proposed methods and render them absolutely superfluous."

In the meantime, this method became law in Hessa; Oldenburg, Mecklenburg, and the Kingdom of Saxony have followed or at least are preparing to do so.

Gentlemen:—It is needless to mention that the successful suppression of cattle tuberculosis is of vast importance in the breeding of cattle. As Dr. Lorenz has stated at Kassel, it would release agriculturists from a burden which has hitherto rested heavily upon them. This means 1% of the capital represented by 300,000 heads of cattle in Hessa alone, even if only the loss of the meat of slaughtered animals is taken into consideration. For the German Empire, therefore, the loss amounts to millions yearly.

But we will also have to calculate the loss in the production of milk which arises from insufficient assimilation of the food, and the lower percentage of nutrient substances contained in this milk, and last but not least I would mention the threatening of wasting diseases and death to humanity.

I shall here enter into the milk question, discussing it first from the agricultural point of view.

You are aware that milk of tuberculous cattle contains tubercle bacilli. If this milk is fed to calves they certainly will be infected. It may take a long time before any distinct symptoms of tuberculosis are shown. Many animals may have a healthy appearance to the end of their lives, but if the tuberculin test is made on animals about three years old, of such a herd, there will hardly be found one among them that does not react. Many of the older animals begin to cough, others develop tuberculosis of the udder, of the kidneys, of the genital organs, etc. The animals with so-called open tuberculosis are the principal cause of spreading the disease, since they distribute the germs all over the stable. We can diminish the danger of infection of newly born calves to a certain extent, but we cannot abolish it, as the virus of the stable is liable to be sucked up by the calf, and other possibilities of infection exist in tubercular stables. I wish merely to remind you

of the fact that the virus of animals with open tuberculosis may find its way into the feed. Germs may also be transferred from one animal to the other through the air, if for instance two animals, of which one is coughing, stand facing each other. But I consider, that the greatest danger of infection is in the feeding of tubercular milk to calves in the earliest stages of life. *Especially young calves infected in this manner and highly sensitive to the tuberculin reaction, are later on disposed to develop the disease in consequence of the germs contained in the air they inhale. But since, in young cattle, we cannot as yet by means of the usual methods of investigation ascertain the injurious effects of the infected milk, only the last mentioned opportunity for infection is taken into consideration by many investigators and the disease usually is attributed to air-infection. This has caused the doctrine of the greater importance of the so-called inhalation tuberculosis. On the other hand, every experienced breeder knows, that in an infected stable under otherwise perfectly equal conditions not all cattle are tuberculous to the same degree, and some even do not appear to be at all infected.. This experience has led to the doctrine of predisposition, because the difference in the conduct of the animals could not be explained.*

The difference in the disposition of grown cattle towards tuberculosis, with equal opportunity for infection, convinced me that we must not look for the cause of infection in the premature life of the single animals, but must find out as to what chances for infection it has had in its early life, and I am fully convinced that the milk question is of decided importance. There is nothing new in this statement. If at present in many breeding places sterilized milk is fed to the calves instead of raw milk, this is solely done because of the danger of infection, and *Dr. Strelinger*, of the Hungarian estate Sarvar, has furnished me the decided proof that he could discriminate, by means of the tuberculin test, between calves fed on raw milk, that is to say from the udder, and those fed on sterilized milk, if the test is made after the calves are more advanced in age. From this point of view, sterilized milk should have the preference, since it would also prevent other infectious diseases. But the matter is not quite so simple in reality. We know from experience that sterilized milk is apt to produce diarrhoea in cattle and thus favor the occurrences of infection processes, and that it is anything but a preventative in dysentery in calves (*Kälbersterbe*). Careful and numerous comparative observations at the estates of Archduke Frederick of Austria (with a large number of cattle) have furnished the proof, that under otherwise equal conditions raw milk-fed calves (from the udder) gained more in weight, within a certain time, than calves fed on sterilized milk. The latter fell behind in weight

about 30% (95,29:154,49). This lack in weight remains throughout their lifetime. For instance, after two to three years, 58% of the young stock which had been raised on sterilized milk had to be rejected for breeding purposes, and similar results have been reported from other estates.

I believe I am not mistaken in the presumption, that not a few breeders have already lost their enthusiasm for raising their calves on Pasteurized milk; because instinctively and merely from the appearance of their cattle they found out what was proven in Teschen by scientific observations.

It can be but a question of time, that we will also consider the feeding of infants with sterilized milk as an evil, even if as a necessary evil, as long as the danger of tubercular infection exists for infants that are brought up on raw cow's milk. For, viewed from a scientific standpoint, it can hardly be doubted that biological fundamental laws will not come to a standstill before man. It is but necessary to change the words "raising of calves" into "raising of infants," to find the moral of what I have stated concerning the milk question with reference to tuberculosis, milk diarrhoea, and physical development.

In favor of milk sterilization for man the hypothesis is cited that typhus, dysentery, scarlet fever, and streptococci diseases are occasionally transmitted through raw milk, and the fact is not realized that the bacilli of these diseases do not come from the udder of the cow, but must first have gotten into the milk from man, and that the most appropriate measures for the prevention of these diseases would be to avoid the infection of the water through bacilli coming from man. It must be admitted that boiled water is inferior for drinking purposes. How much more must this be the case with milk, since its organic constituents undergo still greater changes through the influence of heat than do the inorganic constituents of water.

A common-sense hygiene is exercised regarding our drinking-water from its place of origin to that of its consumption, and should the slightest possibility of infection arise, the water supply would be at once cut off, instead of advising to boil the water before using. Should not the same precautions be taken in regard to the milk? We are compelled to report cases of scarlet fever and other infectious diseases. Whether the scarlet fever bacilli, if during an epidemic they find their way into the milk at the place of production, will be rendered inert through Pasteurization, we do not as yet know. I am almost inclined to doubt it, since the proof has not been furnished that in cases of pretended contagion of scarlet fever through cow's milk, just raw cow's milk had been taken. Be this as it may: Would it not serve the purpose better,

to stop the milk supply from dairies from whence scarlet fever infection may emanate, instead of relying upon it, that the milk will be boiled and through boiling will be rendered innocuous? I am about to remove to danger of infection from tubercular milk through the introduction of cattle immunization.

Gentlemen:—In my former lectures I have often emphasized, in accordance with Koch—although for different reasons—that I do not consider meat which has passed the control of the health department, butter and cheese, dangerous to man, even if a few tubercle bacilli should be contained in this food, because meat, butter and cheese are food for adults. The healthy adult possesses in the mucous membrane of the intestines a protective contrivance which suffices to destroy such small doses of tubercular virus.

As far as healthy grown people are concerned, I am therefore of the opinion, that Ostertag's hygienic demands for the prevention of infection threatening from tuberculous cattle are perfectly satisfactory.

However, if grown people prefer drinking boiled milk to raw milk, this is perfectly rational, since cooking prepares the milk for digestion. I am even inclined to believe that boiled milk is more easily digested by grown people, than raw milk. But this is not the case with newborn infants because of the absence of the gastric juice in stomach and intestines. In mother's milk we find small corpuscles consisting of genuine and unchanged albumin. These corpuscles enter the blood circulation as unchanged albumin. The organ to utilize the boiled and peptonized albumin for the formation of blood is not quite developed in the newborn.

Despite the fact, that I have repeatedly emphasized my above standpoint in the milk food question, overhasty and prejudiced critics have overlooked again and again, that my reformatory efforts just at present concern solely cow's milk used as food for infants. My endeavors are directed to this point: That in cases where it is not feasible to raise the infant on mother's milk or employ a wet nurse, cow's milk is substituted that is unboiled and does not contain bacilli. It cannot be denied and has been acknowledged at all times that mother's milk is the best nourishment for infants. But many mothers will not, or can not take upon themselves this duty. Besides, there are cases where the physician does not consider it advisable for the mother to nurse her baby, either in her own or in the baby's interest, and just here the danger of tuberculosis plays an important rôle. As is well known, the process of tuberculosis is hastened in the mother who nurses her infant, and the baby nursed by a tuberculous mother is threatened by the danger of drinking in with the mother's milk the germs of the disease. Often many years after the child shows

symptoms of scrofula, and still later dies of tuberculosis. Only a small percentage of families are enabled to engage a healthy wet nurse in such cases, the others are compelled to raise the baby on animal's milk. In southern countries goat's milk and ass's milk is given the preference, while with us cow's milk predominates.

But if the milk for this purpose is obtained from a tubercular stable, the same dilemma arises which I have demonstrated to you with reference to the raising of calves. The infant is threatened either by the Scylla of tuberculosis, or by the Charybdis of disturbance of nutrition, by feeding sterilized milk.

There is no doubt that the well-known Soxhlet method for sterilizing milk surpasses all other methods, but intelligent and experienced physicians find again and again that some babies will not thrive on Soxhlet milk and are compelled to change to raw milk, or buttermilk and whey for some length of time; eventually with the addition of Biedert's cream mixture, consisting of sterilized sweet cream, which in my opinion is a valuable addition to the armamentarium of infant's foods. For the heat does not harm this cream-mixture to any extent. The albumin corpuscles are affected most, but they are converted unchanged into sweet buttermilk and sweet whey, which is not the case with conserved milk prepared, for instance, after Gärtner's method.

The simplest, most natural, and cheapest substitute for mother's milk will always be fresh and sweet cow's milk with the necessary dilution and eventually the addition of Biedert's cream-mixture. But we must insist upon one demand, namely that the fresh milk is free from tubercle bacilli, or other generators of diseases. This demand can be satisfied by dairies with stables free from tuberculosis and where the utmost cleanliness of the stables and stable help is insisted upon, and if further the supposition is realized that the milk is not contaminated afterwards, during transportation and until it is fed to the infant.

My own experience has convinced me that raw cow's milk is an unobjectionable food for infants only if not more than 24 hours have elapsed between the time of milking, and the feeding to the infant. This can of course be easily obtained in villages and small towns, but in larger cities the greatest difficulties arise in this direction. Especially for Berlin I have had extensive studies made of this subject. In some parts of the city, there exist of course still a number of dairies; but what I had found there as to the keeping of stables, milking, samples of the milk, and further the possibility and probability of secondary milk infections was perfectly sufficient to condemn the milk, whether raw or sterilized, for infants as well as for adults. In spite of this,

we are compelled to pay a pretty high price for this inferior milk. But I have also found that in Berlin we can get milk delivered to families which answers all requirements, but its price is about five times as high as that of the ordinary milk, which I could not even find out of proportion after careful calculation of the cost of a faultlessly kept dairy on city ground.

Arriving at this point, the question whether it is not possible for country dairies to supply large cities with a faultless milk for infants and children, I commenced to investigate the matter of milk preservation.

For the present I shall not insist upon the destruction of germs as a means of increasing the stability of the milk. I am satisfied to extend the period of stability of raw milk to three days without harm to the antibodies. I think this task can be accomplished by the addition of a minimal quantity of formalin. The cost of this, per quart of milk, would be almost equal to nothing. I shall later on speak about the harmlessness of formalin and also about the proportional quantity recommended by me.

It has been remarked, that some unscrupulous dairymen might be tempted to add a higher percentage of formalin to impure milk, to render it acceptable to the buying public, if the Board of Health should see fit to approve of this manner of preserving milk. This objection is quite reasonable, but an experienced dairyman has directed my attention to an exceedingly valuable means of preventing this. *This means consists in the issuing of licenses by the State to those dairies wishing to make use of the formalin, in order to increase the stability of a faultlessly obtained milk from healthy cows. The revenue of these licenses should then be expended in employing veterinary surgeons whose duty it would be to control the state of health of the milk cows, cleanliness of the dairies, the unobjectionable condition of the fresh milk, and the addition of formalin.*

Provided the formalin milk will prove satisfactory, such an increase in the price as will be an ample equivalent for the money expended for the license, would doubtless be attainable for it.

I have so far spoken of "formalin" and "formalin milk," but must state here that it would be more correct to speak of formaldehyde. "Formalin" is the name chosen by a certain firm for a 40% watery solution of formaldehyde. Other manufacturers call their formaldehyde solutions "formol" or the like. But there is no reason whatever for using the fancy names of single firms in place of the scientific term "formaldehyde." From now on I will therefore call the formaldehyde milk possessing the calculated stability of three days and containing formaldehyde in proportion of 1-40,000 "B. F. Milk."

For the present I shall not recommend the use of this B. F. milk to private families for the nourishment of infants. I have taken occasion to express my opinion on this matter in the Berlin Morning Post of Feb. 5th, this year, as follows:

“When it had been discovered that cherry pits contain prussic acid, timid people refused thenceforth to eat cherries. The milk treatment which, at my instigation, is now tested at some of the hospitals, does not mean an adulteration and cannot fall under the jurisdiction of the health department, but represents a remedy. Until the efficacy of this medicament, as well as its innocuousness, has indubitably been proven, it will be tested only in institutions. I take the most extraordinary precautions in transferring animal experiences to man, and nothing has ever been published that was not perfectly clear to me, and this refers also to my Antitoxin (Diphtheria). And when I am thoroughly convinced, I leave it to the opinion of the specialists for children’s diseases, before I recommend a new harmless treatment to families. Before we can transfer the experiences of bovine practice to human beings, we shall have to await the cooler season and results of the experiments to be made in institutions. During the summer, the milk is more apt to deteriorate and children are more predisposed toward diseases. If we can rely upon B. F. milk for children, as we can rely upon it for calves as proved in Teschen, then—in about a year—I shall be able to test the specific antidotes for tuberculosis in milk. The experiments on calves in Teschen proved to an absolute certainty the superiority of B. F. milk to sterilized milk.

This is my present standpoint, and I shall therefore conclude this lecture with a statement regarding the experiences so far gained in the raising of calves on formaldehyde milk.

At the farm Miedzyswietz, belonging to the Teschen estate, in the year 1899, there were raised out of 39 calves 22 with sterilized and 17 with not sterilized milk, and for eight weeks remained under the closest observation. At the end of this period, it was found that the former had gained at an average only 95.29 per cent. in weight, while the latter showed a gain of 154.49 per cent. Therefore, 11¼ quarts of sterilized, and only 9.5-6 quarts of not sterilized milk had to be consumed in order to gain 2 pounds in weight. One quart of not sterilized milk had caused a gain of 3.1-3 ounces, while the same quantity of sterilized milk caused a gain of only 2.9-10 ounces. The fact that the cattle raised on sterilized milk, when 2 to 3 years old, were rejected for breeding purposes, I have mentioned before.

Similar comparative experiments have been made with B. F. milk for nine months, for the purpose of determining the value of B. F. milk as a nutriment. It remains to be seen what the value of the grown cattle raised on B. F. milk will be. But that they did not fall behind in weight, as compared with calves fed on ordinary, not sterilized milk, during eight weeks of observation, has been proven last year, at the same farm, the calves having gained 151% in weight, at an average, at the end of the eight weeks. The average milk consumption was 646 quarts per calf (formaldehyde milk fed) in 56 days, while sterilized milk-fed calves consumed but 535 quarts per head during the same period. This, I think, speaks for the less palatableness of sterilized milk.

In the above experiments, formaldehyde in the proportion of 1-25,000 was used for the formaldehyde milk. It is my intention to now extend the comparative tests of B. F. milk (1-40,000) to be used for infants, in such a manner that on the same farm always one newborn calf is raised with not sterilized milk, another with sterilized milk, and a third with B. F. milk until the number is large enough to get a sure foundation for the relative nutrient value of the B. F. milk.

At the estate Teschen the formaldehyde milk of stronger concentration (1-25,000) was used for therapeutic motives, because it has proven of great value in suppressing dysentery of calves (Kälbersterbe), especially if the inflamed navel is also treated externally with a 1-2,000 formaldehyde solution.

Here I refer to a passage from an article which was published by me three months ago, and which reads as follows:

"Beginning of October, 1903, experiments were begun in Teschen to feed newborn calves on formaldehyde milk. We obtained very satisfactory results by using this B. F. milk (1-10,000). At an average, each calf gained about 20 pounds (previously only 14 to 16 pounds), they felt fine and thrived wonderfully. In one of the stables we had to overcome dysentery (Kälbersterbe), a dreadful calamity and very difficult to get rid of. Almost every calf died within 48 hours. The moment we fed B. F. milk, there was not another case of dysentery. The disease had disappeared.

"It may be that formaldehyde milk is more easily digested. Its coagulation is very fine, while milk without the addition of the formaldehyde coagulates in big lumps."

In February of this year, the following report was sent me from Teschen:

"Dysentery made its appearance in December, 1903, and was present in a high degree. The calves took sick on the second day after birth; the course of the disease was acute and we were compelled to partly kill and partly sell the calves. To check the disease, various medicaments were employed, such as calomel, tannoform, tannalbin, etc., but without success. Formalin, as it was then used, failed as well.

"The cause of the disease could not be ascertained. Since the calves were fully developed when born, and since they had a good appearance and felt well on the first and second day, we attributed the disease to external influences. But removing the cattle to other stables and a change in nutriment did not afford any relief. Only when we found the cause of the disease in an infectious inflammation of the navel, and when formalin was used internally and externally, our efforts were successful. The improvement was so sudden and remarkable that we could ascribe it only to the use of the formalin. Formalin cannot be valued too highly as a remedy in the raising of calves.

"The stall of the mother should be well disinfected by washing with a 1-1,000 formalin solution, and the navel of the calf cleansed with the same solution; to the milk which is used for the calf there should be added formalin in proportion of 1-10,000. It will suffice to continue this treatment for a few days to avoid the dreaded disease. Later on the calves may be fed with ordinary milk (without formalin).

"Since the time we started this treatment, Dec. 24, 1903, the disease has disappeared; after we had lost 18 calves in succession.

"These favorable results can be attributed only to the application of formalin."

H. EHLE, m. p.

Bazanowitz, Feb. 3d, 1904.

Vidi:

P. MAYER, m. p.,

Chief Inspector.

From Mr. Rösler in Teschen I have received, besides very valuable control tables, a letter dated Feb. 6, 1904, which doubtless will be of interest to you:

"In connection with the tables I have sent you a few days ago, I would like to remark that the unfavorable progress in weight in the calves fed with sterilized milk, has not been noticed in Mien-

dischwetz alone, but complaints in this direction have been received from all districts where sterilized milk has been fed. Sometimes we even noticed a decrease in weight as against the previous week in some of the animals. I would further state that by this method we have lost many calves and dysentery occurred frequently. In my opinion, the deleterious influence of this method of raising is noticeable also in older age. Animals raised this way appear to me less developed and not as lively, especially at the age of 1 to 2 years.

"If you should desire more extensive statistic material regarding the raising with sterilized milk, we can easily furnish you such, since we have a stock of nearly 2,000 milk cows, and had at the time introduced the method of raising cattle on sterilized milk, since we believed, that we would be able to conquer tuberculosis by Dr. Bang's method. Chief Inspector Mayer would no doubt gladly place the data of our other administrations at your disposal.

"Yesterday we received the report from another farm where dysentery had to be overcome; the problem was successfully solved by means of formalin."

It will hardly be necessary to cite further proofs, in order to convince you of the importance of these B. F. milk tests for cattle raising, even if nothing more would be accomplished but the suppression of dysentery and a possibility of preserving milk, avoiding thus the disadvantages of pasteurized milk.

I shall, however, here read you a few communications concerning my vaccination method to prevent tuberculosis:

Firstly, a citation from No. 7 of my "Beiträge" (Dr. Römer), with reference to the estate Wolfshagen i. d. Uckermark:

"Calves which had been inoculated in spring 1903, showed toward summer symptoms of a severe pneumonia. This disease was caused by a worm (*Strongylus micrurus*), as the autopsy of five animals proved. But it showed also, that they were entirely free from tuberculosis. This demonstrated clearly to the owner and to the veterinarian the efficiency of the immunization method, since prior to the introduction of the method tubercular changes had invariably been noticed upon investigation of the slaughtered calves. All immunized calves of the other estates in Mecklenburg enjoy the best of health, and the veterinarian there is thoroughly convinced of the immense value of the immunization method. For in infected stables, according to his experiences, even yearlings died of tuberculosis at the rate of $1\frac{1}{2}$ to 2%. Contrary to

this, the calves immunized 6 to 8 months ago, show no symptoms whatever of tuberculosis."

The report is now completed by important statements of Count Schwerin-Wolfshagen, in a letter dated Feb. 7th, this year, and addressed to Dr. Römer:

"A year has now elapsed, since the first animals were immunized, and I think I need not delay my report any longer. Yesterday and the day before I again carefully examined all animals here and in Schlepkow and I am very pleased to state that all animals apparently enjoy the best of health. Even those that presented themselves to you in such a deplorable condition at the time, in consequence of the lungworms (*strongylus micrurus*) taken up in the respiratory organs on the pasture, are thriving. Of all these animals not one has died since that time. I must here express to you and Mr. Ebeling my sincere thanks, since you saved this stock from sure death by carbol injection. I do not know whether I am mistaken, but in my opinion the immunized yearlings here and in Schlepkow have a much better appearance than the stock in Hornshagen, which have not been immunized. I have not heard one of the immunized calves cough during the whole year, and I therefore take it that all immunized animals are really neither tuberculous, nor do they possess any predisposition toward tuberculosis.

"In consequence of the favorable results here and in Schlepkow, I am now having the stock in Hornshagen vaccinated by Mr. Ebeling."

In conclusion I shall cite a communication from Mr. Rösler in Teschen, of Feb. 6th, this year:

"The feeding experiments with milk from highly immunized cows are already being made, and we shall commence the experiments on guinea pigs on Monday. Last week a half-year-old heifer had to be killed because it had broken a leg. Very thorough macroscopic and microscopic examinations revealed neither tubercular changes, nor tubercle bacilli, although the animal had been kept with a highly infected herd. I had the veterinarian in charge make out a detailed report of this case which I shall file with the vaccination records."

Gentlemen:—I shall here conclude the statements I today wished to make with reference to the suppression of tuberculosis, preservation of milk and raising of calves. If in nothing else, I hope at least to have succeeded by this lecture in inducing you to doubt the prejudiced criticisms of poorly informed so-called

scientific authorities, who claim, that I have been frivolous in recommending and introducing new methods of nutrification, immunization, and treatment. I feel confident you will henceforth examine the unfavorable decisions of the different societies and congresses, as to whether they are not caused by envious motives; as to whether some societies distributing sterilized milk, which they are enabled to do but by soliciting donations, see their work endangered by my method; or whether the spittoon fanatics fear for the success of their propaganda; or whether some academic teachers are afraid to lose their authority over the students, if they are compelled to admit that they still can learn something. We have also large dairy combines that do not wish the competition of the smaller dairymen to grow more successful if they are enabled, with but little cost and labor, to increase the stability of their milk.

For all these obstacles I am thoroughly prepared and believe, that I shall ultimately conquer them.

It will be more difficult to overcome the impediments of the existing Board of Health laws, as far as B. F. milk for the nutrition of infants is concerned. But taking into consideration, how quickly the views on the milk question were changed in Berlin, in favor of insufficiently tested theories which have proved untenable, it would indeed be miraculous if our Board of Health would object to a milk preserving method which is founded on such good results as have been obtained in calves.

But however this may be, you are not hindered by any law to use and test the good wherever you find it.

DISCUSSION

In the Session of the Section for Cattle Breeding of the Agricultural Society for Rhenish Prussia, Regarding the Foregoing Lecture Delivered by Prof. Dr. von Behring.

The session was opened in the afternoon of March 16th, 1904, by the President of the Agricultural Society for Rhenish Prussia, Mr. J. Pauli. In the introduction, Prof. von Behring refers to the importance of the milk question in relation to tuberculosis. This question can be easily solved, as far as tuberculosis is concerned, when we have cattle herds which are absolutely free from tuberculosis, that is, which have been immunized. At the present time, we can of course not take this into consideration. Present

conditions demand the greatest attention to the use of uninjurious milk. The question now arising is: Is it not possible at present to obtain milk for infants from country dairies and convey it to the cities without having it exposed to heat and in the least changed form? It must be admitted, though, that the present method will not accomplish this. However, it is important that this matter be discussed and that attention be directed to the manner of milk production of several model dairies in Berlin. These dairies produce milk containing but few germs, which can be utilized unboiled. Prof. Ficker, of the Berlin Hygienic Institute, intends to publish the results of his tests of milk, sent him by Messrs. Bolle and Grub, in the near future.

The proposed addition of formaldehyde to the milk is not to destroy the germs, but to check their development. If the germs were destroyed by a larger addition of formaldehyde, then the preventative and antibodies contained in the milk would also become inert, just as it is the case with pasteurized milk. This is the reason of the non-success in many cases of infants raised on milk sterilized by heat, and dysentery in calves, which is doing so much damage to our farmers, is also caused by feeding pasteurized milk. Prof. von Behring is convinced by his experiences, that dysentery in calves can be avoided by feeding raw milk with the proportional addition of formaldehyde, in place of boiled milk. It is best to pour the formaldehyde into the milk-pail before milking, as this will insure a perfectly even distribution. Several estates in Bohemia and Mecklenburg have obtained excellent results in the prevention of dysentery (*Kälbersterbe*) by following this method.

The amount of germs in the milk varies in the different dairies. While visiting sanitary dairies, Prof. von Behring became acquainted with prominent dairymen, who had succeeded in reducing the amount of germs in the milk to such an extent that the specific changes took place only 24 hours after milking, which in other milk appeared 8 hours after the milking process. This was accomplished mainly by the following hygienic measures:

1. Perfect drainage, so that the manure and urine could not remain in the stables for any length of time.
2. Special arrangements, that force the cows to step back from their mangers after feeding, and evacuate their fluid and solid excrements into gutters.
3. Careful cleansing of tails and udders; the latter should be cleansed *dry*, as this manner has proven itself to be much more efficient than washing, recommended in former times.

The udder is first thoroughly wiped with a dry cloth, then with a cloth saturated with vaselin, and last it is rubbed dry with wheat-bran. This insures perfect cleanliness of the udder which can be touched with a white glove without staining the latter, of which fact the speaker had convinced himself when inspecting the Victoria Park Dairy in Berlin.

Stable hygiene without disinfectants is possible and worthy of the highest consideration. Holders of licenses for the sale of B. F. milk should be bound to follow certain laws regarding stable hygiene.

Count Spee-Wesel here inquires, if Prof. von Behring is still of the same opinion as a year ago, regarding the difference between human and bovine tubercle bacilli; further, when the vaccination should be made and how long the animals would remain immune, and, finally, would the addition of formaldehyde destroy all disease germs in the milk?

Prof. von Behring distinctly states that he would like to have it distinctly understood that his immunization method is not to be confounded with the tuberculin vaccination. The latter being a very good means in diagnosing tuberculosis, while his method is to *exterminate* tuberculosis, and, judging from experiences so far, he is confident of success. There is no doubt today that the assertion of Prof. Schütz, of last year, regarding the diversity of human and bovine tuberculosis, was based on an erroneous view. Today, most of the adherents to this theory are aware of this, and Prof. Schütz himself has taken occasion to revoke its main points in the Berlin medicinische Zeitschrift. Besides, Prof. Schütz's claims should be accepted with great caution, according to Prof. von Behring's personal experiences which he has partly reported in an official communication, and partly intends to publish in No. 8 of his "Beiträge zur experimentellen Therapie." The danger of infection of young cattle through older animals would remain under all circumstances. It has not at all been proved, that the transmission of human tuberculosis could ensue from man to man only. We must strictly discriminate between an infection and a subsequent serious sickness. Most human beings are infected, but only a small fraction of the infected die of tuberculosis. Infection takes place principally in the earliest stage of life and the question, in which manner and to which extent the infection becomes effective, is a question of quantity. Healthy adults possess in their digestive organs an efficient protection against infection. But today it is taken for granted, that the virus of bovine and that of human tuberculosis are of like species. The speaker

considers it very possible that Prof. Koch, after his return from Africa, will be of the same opinion.

The hereditariness of tuberculosis Prof. von Behring does not consider such a great danger as do other investigators, although he admits that family tuberculosis is of great consequence. With reference to this, Prof. von Behring states the following :

"In many cases the first-born child remains healthy because it was born at a time when the tuberculosis of its parents was still in an early stage. In time the disease in either father or mother spreads, and consequently the accumulation of tubercle bacilli increases. So each later born child is exposed to greater danger from infection, in its first stage of life, at a time where it still lacks the protecting mucous membrane of the intestines. The conditions in the stables are similar. If we speak of phthisic apartments, we might as well speak of tubercular (Perlsucht) stables, that is old stables where tuberculous cattle have been kept for years."

To the question, at what age calves should be immunized, Prof. von Behring replies as follows: It has been proved by experiments, that it is best to inoculate calves at an average age of four weeks and, that the age of three months, or at the very latest four months, should be the age limit for the immunization of calves.

The animals will probably remain immune all their lifetime. But experiences dating back only three to four years, nothing definite can of course be said as to whether this holds good also to extraordinary conditions, for instance in great danger of infection. But under general conditions, immunized calves will remain immune for their lifetime.

The addition of formaldehyde does not tend to destroy bacilli, but it retards the process of milk decomposition and preserves the antibodies contained in the milk. The procedure is very simple. Prior to milking, 1 ccm. formaldehyde (in 20 ccm. milk or water) is poured into a milk-pail holding about 10 quarts.

Von Wülfig remarks that, if vaccination takes place only after four weeks, it is possible that the animals are already infected.

Prof. von Behring responds that his medium immunizes young calves even if they have been previously infected. Experience has proved that inoculation is even more effective if infection has previously taken place. He reminds his hearers of the similar method and treatment of vaccination against hydrophobia.

To make himself better understood, he wished to draw a parallel between Pasteur's vaccination and his immunization method. In order to insure immunization it is not necessary to vaccinate the animals before infection takes place. The vaccination against rabies is never performed before, but after the person has been bitten by an hydrophobious dog; otherwise all people would have to be vaccinated, because no one knows whether or not he will be bitten today, or tomorrow. However, vaccination must of course be made before any symptoms of the disease appear, in other words, in the "period of incubation." The effects of the tubercle virus, during the incubation period, are not clinically perceptible, which is also the case in hydrophobia, but they are shown by peculiar changes in the blood and also by an increased sensibility to tuberculin. If the inner organs of an entire herd are affected, then we must look upon it as the outbreak of the disease. If this is the case, then it will be impossible to obtain a sure immunization, because the incubation period is passed, and the disease is developed. But this is not the case with calves four weeks after infection, unless, as in very rare cases, the disease has broken out in utero, or infection has been especially intensive. Infection of calves ensues very frequently, already in the first four weeks of life, through tubercular milk. It has been observed that such infected calves reacted strongly to the first injection and Prof. von Behring believes, that possibly these calves have through the first injection attained such a high degree of immunity that a second injection is not needed. But he would like to have it expressly understood that the experiments made in that direction so far are but preliminary tests, and that for the present the second injection should certainly be made.

Dr. Havenstein refers to the many nutrification experiments made at the time by Prof. Dr. Ostertag at the Berlin Veterinary College, which had proved that the milk of cows merely reacting to the tuberculin test is not injurious. In his opinion, these results and Prof. von Behring's experiences could well be brought into conformity. The age of the test-animal will doubtlessly play a decisive rôle. Concerning the preservation of milk, according to Prof. von Behring's method (addition of formaldehyde), he would like to put the question, if the lately so often mentioned "ice or cold milk," according to the improved and simplified method of Helm, would not answer the demands. Prof. von Behring remarks, that he highly appreciates Dr. Ostertag's endeavors, to have all cattle with external tuberculosis, or clinically

recognizable tuberculosis condemned, thus destroying the most dangerous animals and in time establish stocks free from tuberculosis. But at any rate, Dr. Ostertag's method is a restriction, but not a removal of the danger, while Prof. von Behring endeavors to gradually attain the absolute extermination of tuberculosis. Prof. von Behring also takes this opportunity to direct attention to the cheapness of his method, as compared with the enormous loss to the breeder by tuberculosis. The general application of the method is easily possible, since every animal need only be inoculated at the earliest age in order to keep immune, under general conditions, for a lifetime.

Concerning the preservation through the influence of heat, or great cold, Prof. von Behring states, that sterilizing will surely destroy the preventative and anti-germs in the milk, while, when applying the refrigerating process, decomposition will set in very quickly after the milk has been brought up to normal temperature. It is, therefore, a fact that the milk deteriorates, and neither method is commendable. This is of vast importance to dairymen. Of course as long as "ice milk" is kept at its low temperature, decomposition will not set in. *Bacterium coli commune* increase enormously in "ice milk," and even more so in sterilized milk, in comparison with raw milk, within a few hours after having been kept at the normal temperature. It is generally known that "ice milk" will "turn" quicker than a non-objectionable raw milk kept at a temperature above 35° F.

Prof. Hansen, of Poppelsdorf, intends to test Prof. von Behring's method at the academic model dairy. He therefore inquires, as to whether it is permissible to feed immunized calves on not quite unobjectionable milk, and also on skimmed milk. He states that the Academy of Agriculture has introduced the improved Helm's method for milk refrigeration and that very good results have been obtained in regard to the stability of the milk; he therefore regrets all the more that, according to Prof. von Behring's deductions, this milk too should be pronounced as objectionable food for human beings, and that the elegant contrivances for the production of this milk must now be considered worthless.

Prof. von Behring refers to the bacteriological experiments which have been made at Marburg and Berlin with raw, sterilized, and ice milk, which proved a decided increase of germs in the ice milk as compared with raw milk, both being kept under equal conditions. He states that skimmed milk and not quite unobjec-

tionable milk may be fed to *immunized* calves without hesitation. However, milk of highly tuberculous cows should not be fed, since this contains an abundance of tubercle bacilli; and this can of course be easily avoided.

Mr. Leufgen, dairyman, refers to the great danger of spreading tuberculosis through the dairy societies; also to the epidemic dysentery (*Kälbersterbe*), which certainly often proves a calamity and is apt to drive the owner to despair.

Prof. von Behring replies that in regard to the suppression of dysentery in calves good results have been obtained with formaldehyde milk, and that only a stronger solution must be used for combatting this disease. While for nutrification purposes the proportion should be 1-40,000, in cases of dysentery formaldehyde must be used in proportion of 1-20,000; or, if formalin solution (40%) is used, the proportion must be 1-8,000. The formaldehyde addition will cause the anti-corpuscles to enter the mucous membrane of the intestines and stomach of newborn calves in a sufficiently effective condition which is not the case with sterilized milk. In the epidemic dysentery (*Kälbersterbe*) we have an affection of the stomach and the intestines, which in most cases is caused by an infection of the navel by bacilli which find their way into the blood and digestive organs through the umbilical cord. The affected animals should therefore be treated not alone internally, but also externally by cleansing the navel with formaldehyde solution 1-2,500 or formalin solution 1-1,000. It is also of great importance to have the clothing of the stable help disinfected, and the stables, especially the stalls, thoroughly washed and disinfected with hot soda solution. According to experiences so far, it can be said that the successful suppression of epidemic dysentery in calves (*Kälbersterbe*) can be obtained by means of formaldehyde.

HERE THE DISCUSSION CLOSES.

The president of the Agricultural Society for Rhenish Prussia in conclusion thanks Prof. von Behring for the thorough information given in response to the questions put. The active interest which has found expression especially in the discussion he considers the best evidence of the great importance which dairymen and breeders attribute to the investigations of Prof. von Behring.



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